**Supplementary Information**

# Tree height and hydraulic traits shape growth responses across droughts in a temperate broadleaf forest

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While there were several R-packages we used for a specific purpose in our methods, numerous packages were immensely helpful for this research behind the scenes. As in all of science, this study is a representation of the work done by both the authors of this paper as well as countless others. While acknowledging everyone is impossible, we want to at least give thanks to those who made this work possible.

R-packages not already cited in the main manuscript include the following, listed alphabetically by corresponding package name:

(**???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; **???**; Wickham, 2019; Allaire *et al.*, 2020; Gagolewski *et al.*, 2020; R Core Team, 2020; Xie, 2020)

Table S1: Species-specific bark thickness regression equations

| Species | Equations | $R^2$ |
|---|---|---|
| Carya cordiformis | ln[B]=-1.56+0.416*ln[DBH] | 0.226 |
| Carya glabra | ln[B]=-0.393+0.268*ln[DBH] | 0.040 |
| Carya ovalis | ln[B]=-2.18+0.651*ln[DBH] | 0.389 |
| Carya tomentosa | ln[B]=-0.477+0.301*ln[DBH] | 0.297 |
| Fagus grandifolia | ln[B]=1*ln[DBH] | |
| Fraxinus americana | ln[B]=0.418+0.268*ln[DBH] | 0.256 |
| Juglans nigra | ln[B]=0.346+0.279*ln[DBH] | 0.246 |
| Liriodendron tulipifera | ln[B]=-1.14+0.463*ln[DBH] | 0.545 |
| Quercus alba | ln[B]=-2.09+0.637*ln[DBH] | 0.603 |
| Quercus prinus | ln[B]=-1.31+0.528*ln[DBH] | 0.577 |
| Quercus rubra | ln[B]=-0.593+0.292*ln[DBH] | 0.087 |

Table S2: Species-specific height regression equations

| Species | Equations | X.R.2. |
|---|---|---|
| Carya cordiformis | ln[H] = 0.332+0.808*ln[DBH] | 0.874 |
| Carya glabra | ln[H] = 0.685+0.691*ln[DBH] | 0.841 |
| Carya ovalis | ln[H] = 0.533+0.741*ln[DBH] | 0.924 |
| Carya tomentosa | ln[H] = 0.726+0.713*ln[DBH] | 0.897 |
| Fagus grandifolia | ln[H] = 0.708+0.662*ln[DBH] | 0.857 |
| Liriodendron tulipifera | ln[H] = 1.33+0.52*ln[DBH] | 0.771 |
| Quercus alba | ln[H] = 0.74+0.645*ln[DBH] | 0.719 |
| Quercus prinus | ln[H] = 0.41+0.757*ln[DBH] | 0.886 |
| Quercus rubra | ln[H] = 1.00+0.574*ln[DBH] | 0.755 |
| all | ln[H] = 0.839+0.642*ln[DBH] | 0.857 |

Table S3: Monthly Palmer Drought Severity Index (PDSI), and its rank among all years between 1950 and 2009 (driest=1), for focal droughts.

| year | month | PDSI | rank |
|---|---|---|---|
| 1966 | May | -2.98 | 2 |
| | June | -3.40 | 2 |
| | July | -4.08 | 2 |
| | August | -4.82 | 1 |
| 1977 | May | -2.96 | 3 |
| | June | -3.28 | 3 |
| | July | -3.61 | 3 |
| | August | -3.68 | 3 |
| 1999 | May | -3.63 | 1 |
| | June | -4.21 | 1 |
| | July | -4.53 | 1 |
| | August | -4.64 | 2 |

Table S4. Individual tests of species traits as drivers of drought resistance, where $Rt$ is used as the response variable.

| | | all droughts | | 1966 | | 1977 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|
| variable | category | ΔAICc | coefficients | ΔAICc | coefficients | ΔAICc | coefficients | ΔAICc | coefficients |
| xylem porosity | R | -0.80 | 0.0630 | 2.29** | 0.190 | 1.92* | -0.152 | 3.36** | 0.1500 |
| | D/SR | | 0.0000 | | 0.000 | | 0.000 | | 0.0000 |
| $PLA$ | | 6.70 | -0.0140 | 9.13** | -0.025 | -0.32 | -0.010 | -0.95 | -0.0070 |
| $LMA$ | | -2.01 | 0.0002 | -1.9 | 0.001 | -1.68 | -0.002 | -2.03 | 0.0003 |
| $\pi_{tlp}$ | | 1.33 | -0.1740 | -1.65 | -0.107 | 1.23* | -0.245 | -0.1 | -0.1690 |
| $WD$ | | -1.97 | -0.0310 | -1.26 | -0.206 | -1.44 | -0.154 | 0.66 | 0.2720 |

Variable abbreviations are as in Table 2. ΔAICc is the AICc of a model excluding the trait minus that of the model including it.

*ΔAICc > 1: variable meets ΔAICc criterion for inclusion in full model

**ΔAICc > 2: variable is considered significant as an individual predictor (and meets ΔAICc criterion for inclusion in full model)

Table S5. Individual tests of species traits as drivers of drought resistance, where $Rt_{ARIMA}$ is used as the response variable.

| | | all droughts | | 1966 | | 1977 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|
| variable | category | ΔAICc | coefficients | ΔAICc | coefficients | ΔAICc | coefficients | ΔAICc | coefficients |
| xylem porosity | R | -1.46 | 0.0430 | 0.95 | 0.1520 | 2.84** | -0.171 | 2.27** | 0.155 |
| | D/SR | | 0.0000 | | 0.0000 | | 0.000 | | 0.000 |
| $PLA$ | | 4.5** | -0.0120 | 10.15** | -0.0240 | -0.9 | -0.008 | -1.67 | -0.005 |
| $LMA$ | | -1.99 | -0.0003 | -2.02 | 0.0005 | -0.42 | -0.003 | -1.9 | 0.001 |
| $\pi_{tlp}$ | | 0.41 | -0.1500 | -1.94 | -0.0530 | -0.53 | -0.179 | 0.04 | -0.200 |
| $WD$ | | -1.94 | -0.0400 | -0.08 | -0.3040 | -1.57 | -0.142 | 0.83 | 0.316 |

Variable abbreviations are as in Table 2. ΔAICc is the AICc of a model excluding the trait minus that of the model including it.

**ΔAICc > 2: variable considered significant as an individual predictor

Table S6. Summary of top full models for each drought instance, where $Rt$ is used as the response variable.

| drought | ΔAICc | $R^2$ | Intercept | $ln[H]$ | $ln[TWI]$ | $ln[H] * ln[TWI]$ | $PLA$ | $\pi_{tlp}$ |
|---|---|---|---|---|---|---|---|---|
| **all** | **0.000** | **0.12** | **1.131** | **-0.057** | **-0.086** | **-** | **-0.012** | **-0.113** |
| | 0.583 | 0.11 | 1.423 | -0.055 | -0.086 | - | -0.013 | - |
| | 0.726 | 0.12 | 1.537 | -0.202 | -0.326 | 0.082 | -0.012 | -0.114 |
| | 1.352 | 0.11 | 1.826 | -0.198 | -0.324 | 0.081 | -0.013 | - |
| **1966** | **0.000** | **0.25** | **1.622** | **-0.135** | **-** | **-** | **-0.025** | **-** |
| **1977** | **0.000** | **0.22** | **0.503** | **-** | **-0.144** | **-** | **-** | **-0.24** |
| | 0.908 | 0.21 | 1.069 | - | -0.144 | - | - | - |
| | 0.988 | 0.22 | 0.568 | -0.03 | -0.139 | - | - | -0.246 |
| | 1.144 | 0.24 | 0.684 | - | -0.142 | - | -0.007 | -0.204 |
| | 1.267 | 0.22 | 1.211 | - | -0.141 | - | -0.01 | - |
| **1999** | **0.000** | **0.18** | **1.061** | **-** | **-0.102** | **-** | **-** | **-** |
| | 0.023 | 0.19 | 0.659 | - | -0.101 | - | - | -0.169 |
| | 0.954 | 0.19 | 1.157 | - | -0.1 | - | -0.007 | - |
| | 1.513 | 0.21 | 0.783 | - | -0.1 | - | -0.005 | -0.145 |
| | 1.803 | 0.18 | 1.024 | 0.013 | -0.103 | - | - | - |
| | 1.901 | 0.19 | 0.635 | 0.011 | -0.102 | - | - | -0.166 |

Models are ranked by AICc. Shown are all models whose AICc value falls within 2.0 (ΔAICc<1) of the best model (bold).

Table S7. Summary of top models for each drought instance, where $Rt_{ARIMA}$ is used as the response variable.

| drought | ΔAICc | $R^2$ | Intercept | $ln[H]$ | $ln[TWI]$ | $ln[H] * ln[TWI]$ | $PLA$ | $\pi_{tlp}$ | $(1\|sp)[novariables]$ |
|---|---|---|---|---|---|---|---|---|---|
| **all** | **0.000** | **0.09** | **1.125** | **-0.307** | **-0.506** | **0.140** | **-0.012** | | |
| | 0.425 | 0.10 | 0.879 | -0.310 | -0.508 | 0.140 | -0.011 | -0.096 | |
| | 1.208 | 0.09 | 0.424 | -0.060 | -0.100 | | -0.012 | | |
| | 1.695 | 0.10 | 0.178 | -0.061 | -0.100 | | -0.011 | -0.095 | |
| **1966** | **0.000** | **0.23** | **1.660** | **-0.154** | | | **-0.024** | | |
| | 1.393 | 0.23 | 1.735 | -0.152 | -0.047 | | -0.024 | | |
| | 1.457 | 0.23 | 1.859 | -0.152 | | | -0.025 | 0.078 | |
| **1977** | **0.000** | **0.16** | **1.130** | | **-0.180** | | | | |
| | 0.424 | 0.16 | 2.453 | -0.461 | -0.896 | 0.250 | | | |
| | 0.688 | 0.17 | 0.720 | | -0.179 | | | -0.173 | |
| | 0.922 | 0.17 | 2.040 | -0.466 | -0.898 | 0.251 | | -0.180 | |
| | 0.927 | 0.17 | 1.248 | | -0.177 | | -0.008 | | |
| | 1.322 | 0.17 | 2.569 | -0.461 | -0.893 | 0.250 | -0.008 | | |
| | 1.709 | 0.15 | 1.183 | -0.020 | -0.177 | | | | |
| **1999** | **0.000** | **0.20** | **0.563** | | **-0.076** | | | **-0.200** | |
| | 0.064 | 0.19 | 0.421 | | | | | -0.202 | |
| | 0.127 | 0.18 | 1.036 | | -0.077 | | | | |
| | 0.256 | 0.18 | | | | | | | 0.899 |
| | 1.777 | 0.20 | 0.529 | 0.016 | -0.078 | | | -0.195 | |
| | 1.797 | 0.20 | 1.101 | | -0.076 | | -0.004 | | |
| | 1.815 | 0.18 | 0.986 | 0.018 | -0.079 | | | | |
| | 1.838 | 0.20 | 0.972 | | | | -0.005 | | |
| | 1.933 | 0.19 | 0.391 | 0.012 | | | | -0.199 | |
| | 1.979 | 0.21 | 0.612 | | -0.075 | | -0.002 | -0.190 | |
| | 1.999 | 0.21 | 0.482 | | | | -0.002 | -0.190 | |

Models are ranked by AICc. Shown are all models whose AICc value falls within 2.0 (ΔAICc<1) of the best model (bold).

Allaire J, Xie Y, McPherson J, Luraschi J, Ushey K, Atkins A, Wickham H, Cheng J, Chang W, Iannone R. **2020**. *Rmarkdown: Dynamic documents for r.*

Gagolewski M, Tartanus B, IBM, Unicode, Inc., Unicode, Inc. **2020**. *Stringi: Character string processing facilities.*

R Core Team. **2020**. *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Wickham H. **2019**. *Stringr: Simple, consistent wrappers for common string operations.*

Xie Y. **2020**. *Knitr: A general-purpose package for dynamic report generation in r.*

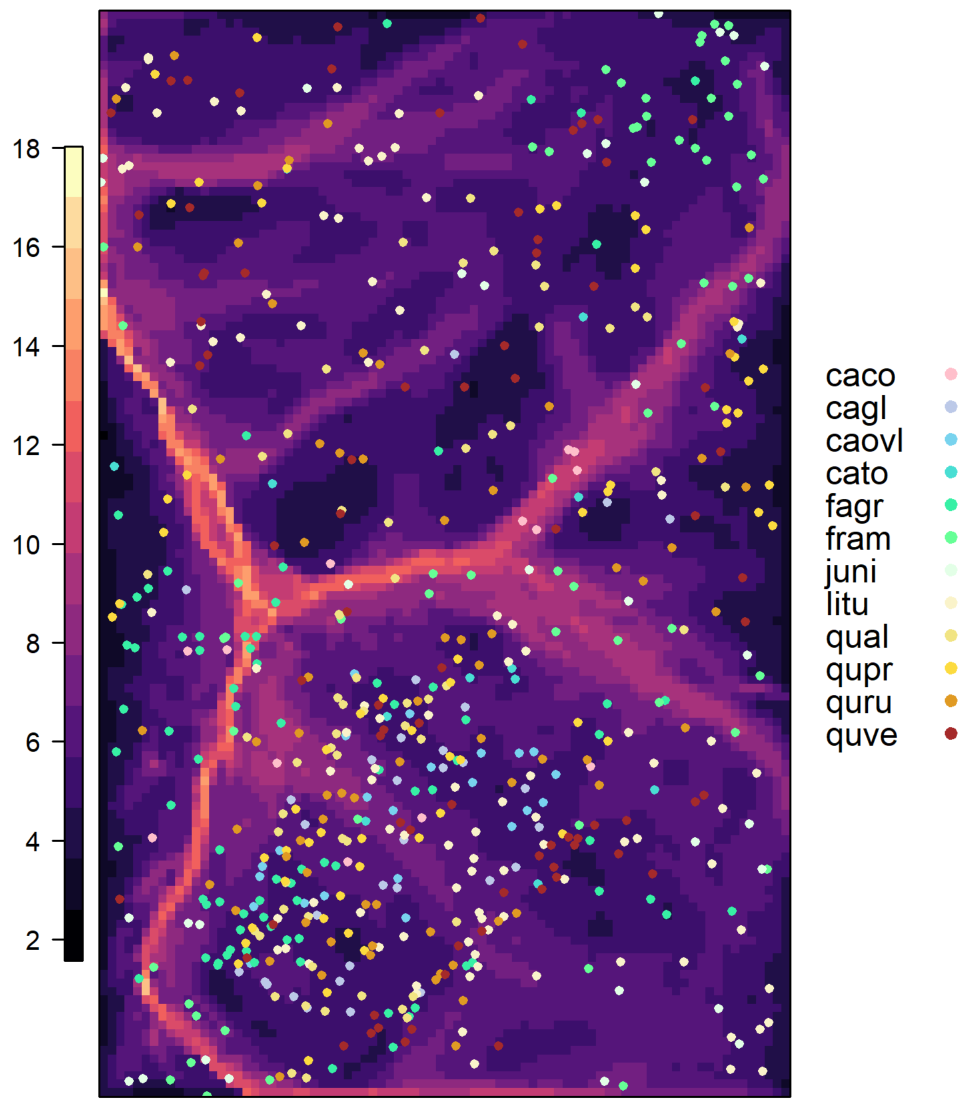


Figure S1: Map of ForestGEO plot showing TWI and location of cored trees

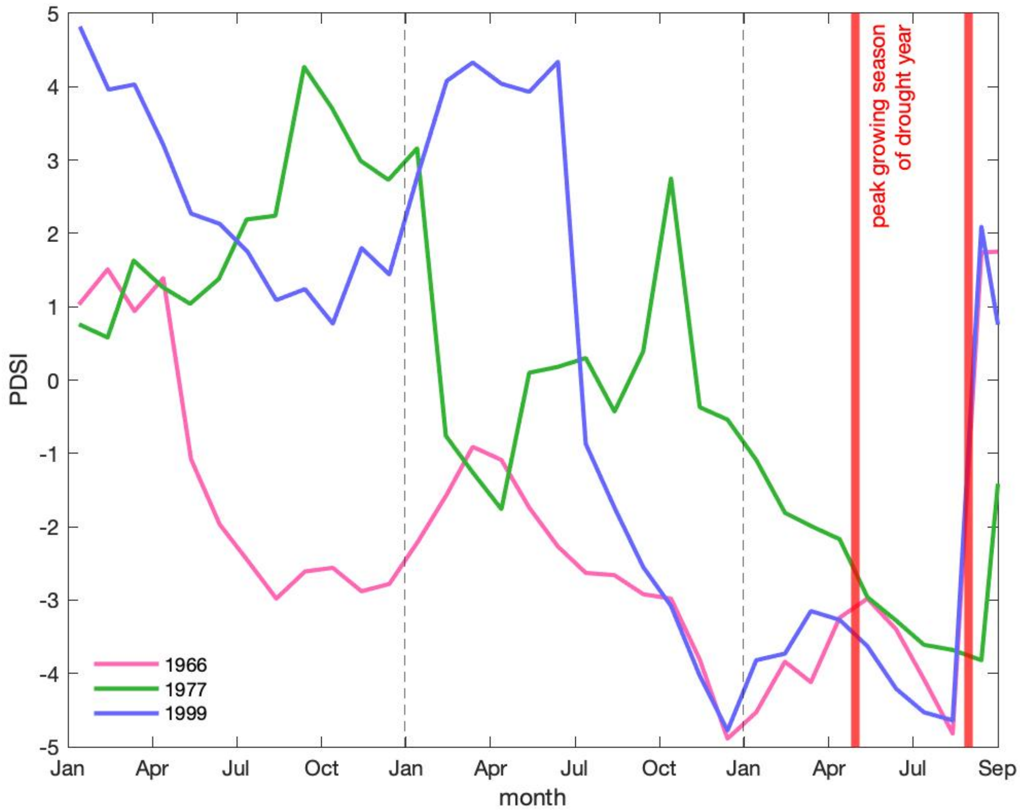


Figure S2: Time series of Palmer Drought Severity Index (PDSI) for the 2.5 years prior to each focal drought

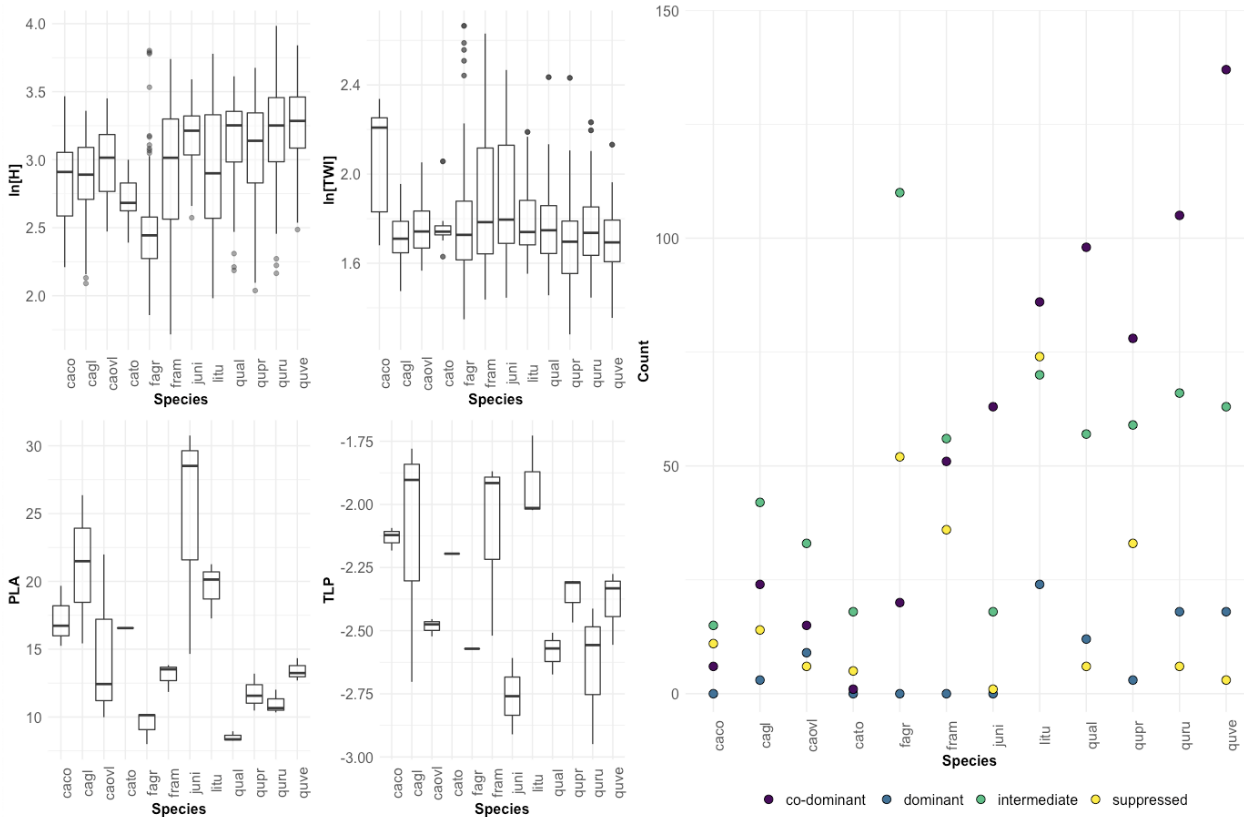


Figure S3: **PLACEHOLDER**

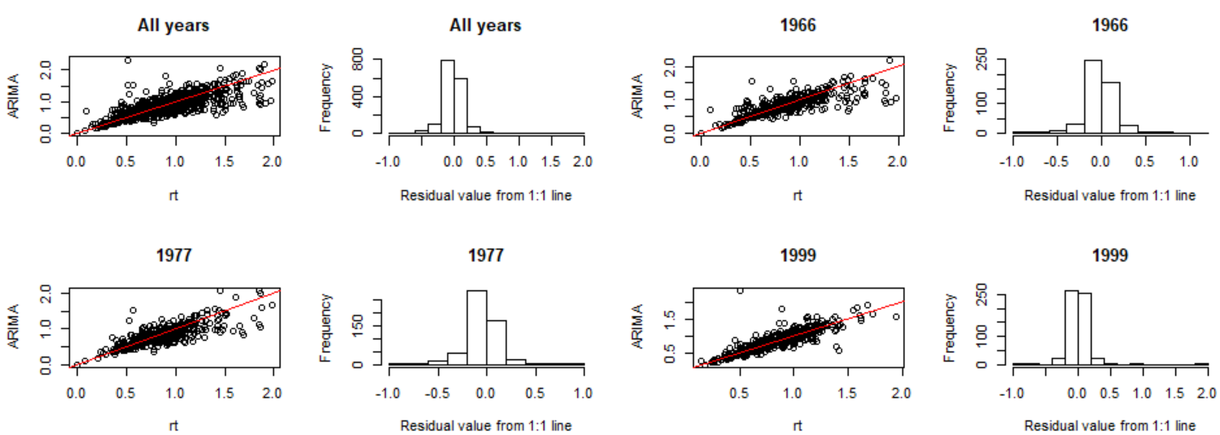


Figure S4: Comparison of $Rt$ and $Rt_{ARIMA}$ results, with residuals, for each drought scenario

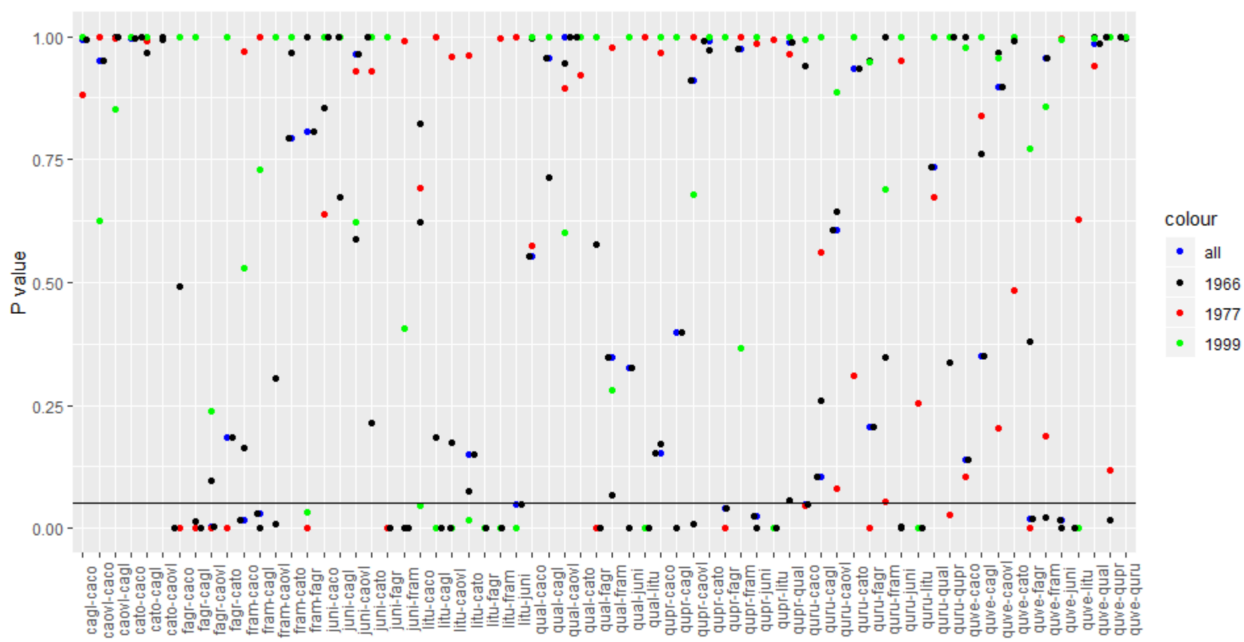


Figure S5: **PLACEHOLDER**